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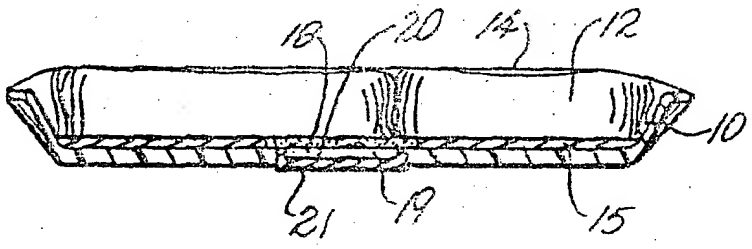
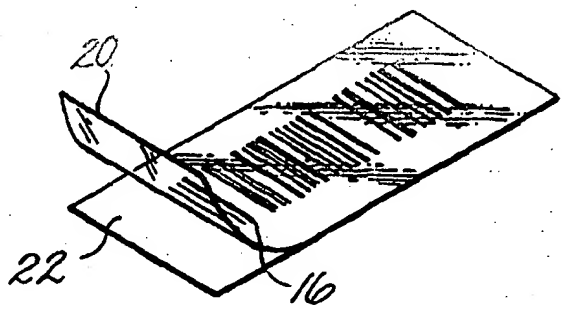
(54) Title: DETECTION OF CONTAMINANTS IN FOOD

(57) Abstract

A food contamination detector comprises an indicator (16) bound to a substrate (20), wherein the indicator is in communication with juices from food (12) to be tested for the presence of a toxin. A means for changing the color of the indicator when the toxin is present in the juices from the food is provided to indicate that the food is contaminated.





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DETECTION OF CONTAMINANTS IN FOOD

Related Applications

This application is a continuation in part of U.S. Application Serial No. 08/064,521 filed May 19, 1993, which is incorporated herein by reference.

Field of the Invention

The present invention relates to detection of the presence of toxic contaminants in food.

Background of the Invention

Over the past several years there has been increasing concern over the safety of our food supply. Contamination of food can come from a variety of sources and the type of contamination possible is often dependent on the food involved.

Most animal derived food products, such as raw meat, are exposed to the possibility of contamination before, during or after processing. Such contamination comes from, for example, contact with faecal matter at the slaughter house, from handlers of the food products at any stage of the processing of the food products or from toxins, both naturally occurring and man-made, present in the environment where the food was grown or processed. In most cases, contamination is minor and, if the food is prepared properly, is not a serious threat to the consumer. However, while the contamination of food is generally low, *i.e.* few bacteria per gram of the food, if

the food is not stored under satisfactory conditions or stored for long periods of time, contaminants, such as bacteria, grow to become a serious threat to the eventual consumer of the products. Even if the food products reach the market in an acceptable condition, subsequent treatment by the consumer may lead to the development of serious contamination of the food.

A number of incidents and factors have lead to the growing concern over the food supply. These include:

raw chicken and egg products have been found to be contaminated with *Salmonella* and inadequate cooking of such products has led to serious illness or death of persons who have consumed the contaminated products;

inadequately pasteurized milk products have been found to be contaminated with *Listeria* which has lead to serious illness or death of consumers of the products;

a highly toxic strain of *E. coli* has lead to the death of several people who consumed prepared beef products which had been inadequately cooked;

a number of toxins are known, such as ciguatoxins, which contaminate fish. These toxins are not inactivated or destroyed by cooking and so their presence in fish is a threat to any consumer of the product;

shell fish, such as oysters, concentrate any contaminants present in the water in which they grow and, since they are frequently eaten raw, pose a threat to the health of consumers; and

fish is increasingly eaten raw which adds to the possibility of increased outbreak of illness from water borne contaminants.

The only means the consumer has of determining if the food they purchase is contaminated is by visual inspection and by smell. These are usually inadequate to detect contamination.

There is a need for a reliable way to detect if a food product purchased by a consumer is fit for consumption. Any solution to this problem should be relatively inexpensive and able to detect a number of agents capable of causing illness. It should also be simple to "read" so that a consumer, who does not have access to sophisticated testing equipment or specialized knowledge, can readily determine if the products they have purchased are free from contamination.

Summary of the Invention

The present invention relates to a food contamination detector. The food contamination detector comprises an indicator bound to a substrate. The indicator is in communication with juices from food which are to be tested for the presence of a toxin.

A means for changing the color of the indicator when the toxin is present in the juices from the food is provided to indicate that the food is contaminated. In one embodiment of the invention the means for changing the color comprises a labeled antibody which dissociates from the substrate in the presence of a toxin. In another embodiment the means for changing color comprises a labeled antibody which binds to the substrate in the presence of a toxin. In another embodiment the change in color results in a change in a bar code.

Brief Description of the Drawings

These and other features and advantages of the present invention will be better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a top view of a packaged food product;

FIG. 2 is a bottom view of the packaged food product with a bar code detector system;

FIG. 3 is a side sectional view of the packaged food product showing the bar code detector system in the package;

FIG. 4 is one embodiment of the bar code detector system of the present invention, prior to attachment to a food package;

FIG. 5 is a schematic diagram of a bar code reader for use in the present invention;

FIG. 6 is a side sectional view of another embodiment of the bar code detector system in a package tray without food;

FIG. 6A is an enlarged view of part of FIG. 6;

FIG. 7 is a perspective view of the bottom of the absorbent liner of FIG. 6 with one component of the bar code system attached;

FIG. 8 is a front view of the component shown in FIG. 7;

FIG. 9 is a front view of another component of the bar code system of FIG. 6;

FIG. 10A is a front view of the components of FIGs. 8 and 9 as they appear from the outside of the food package in the absence of contamination;

FIG. 10B is a front view of the components of FIGs. 8 and 9 as they appear from the outside of the food package in the presence of contamination;

FIG. 11 is a side sectional view of another embodiment of a bar code detector system in a package tray without food;

FIG. 12 is a perspective view of a liner for use in a variation of the bar code system of FIG. 11;

FIG. 13 is a perspective view of a carcass indicator strip incorporating principle of the invention prior to reaction with toxins; and

FIG. 14 is a perspective view of the carcass indicator strip of FIG. 13 after reaction with toxins.

Detailed Description of the Specific Embodiments

The present invention uses an indicator which may be in the form of words, symbols or part of a bar code that identifies the product at point of purchase, sale, or distribution as a detector system for toxins and other contaminants that may be present in food products. As used herein toxin means chemicals or pathogenic organisms which may be transferred from food to the consumers of the food, or other agents which may be toxic or result in illness in the consumer of the contaminated food products.

The invention is described in the context of bar codes because this is currently the prevalent way to identify food products, including information about product type, quantity, price, unit price, and origin in a machine readable manner. The invention is applicable, however, to other product identifying systems, machine readable and/or readable to a human. When the term "visible" is used herein, it means visible or readable by a bar code reader or other scanning apparatus.

The same reference numbers are used throughout the drawings to identify similar parts or elements.

Food products are often "mass produced" and sold at retail outlets in prepackaged containers such as that illustrated in FIGs. 1-3. Typically, such packages include a styrofoam tray 10 which contains the food product 12. The tray and food are sealed in a transparent plastic wrap material 14. An absorbent pad 15 lies between food product 12 and the inside bottom of tray 10. A bar code system 16 is used on the products for scanning at the check-out register (FIG. 5), to reduce errors in totaling purchases and for stock control. The bar code system comprises a series of bars which represent a number, identifying the product. In the practice of the present invention the product identifying system, e.g., the bar code system, also serves the purpose of detecting toxins in the food products.

In the embodiment of FIGs. 1-3, bar code system 16 is printed on a transparent membrane or substrate 20. One side of substrate 20 has a self-adhesive surface for attachment to the interior of tray 10 and the other side of substrate 20 has printed on it bar code system 16. The bottom of styrofoam tray 10 has a rectangular hole 18. Hole 18 is covered by a window 21 formed by a transparent sheet of material such as MYLAR® (a trademark of DuPont) using a suitable adhesive to seal the MYLAR to the styrofoam material. Hole 18 and window 21 also serve as a collector 19 for liquids and juices from food product 12 so the latter can come into contact with bar code system 16. Substrate 20 can be prepared with a peelable, protective release layer 22 (FIG. 4), which covers bar code system 16 prior to its application to a package. At the site of packaging of food product 12, release layer 22 is peeled off and the adhesive side of substrate 20 is placed on the inside surface of window 21 so that bar code system 16 faces the interior of the package and is exposed to the juices of food product 12. Alternatively, substrate 20 could also serve as the window, in which case it would be attached to, cover, and seal hole 18.

The bar code system is formed by labeled antibodies bound to antigens. The labeled antibodies function as an "ink" and are "printed" in a bar code pattern on the transparent substrate 20. First, the antigens are bound to the entire surface of substrate 20 or the portion of its surface on which the bar code system is to be placed. Then, the bar code system is applied to the antigen coated surface of substrate 20 by a bar code printer, using the labeled antibody as the ink. Preferably, bar code system 16 serves the normal product identifying function of a bar code, i.e., it represents price, price per unit, type of product, origin, and quantity or weight information. As illustrated in FIG. 5, food packages carrying bar code system 16 are passed under a bar code scanner or reader 24 mounted on a counter 25 at the point

of sale to read the product information in the usual way. A store computer 26 processes this information to totalize the amount of purchase and to manage inventory.

The bar code system for use in the invention is prepared by irreversibly binding an antigenic determinant of toxins or contaminants of interest to the transparent substrate. The antigenic determinant may be a small portion of the toxin, which is specific for that toxin, it may be the toxin itself, an analog of the toxin or other compound which is capable of "mimicking" the toxin, or pathogenic microorganisms, all of which are referred to herein as "toxins." Substrates suitable for binding the toxin are well known in the art. If substrate 20 serves as window 21 it must be impervious to the food juices. Suitable substrates include substrates such as those made from activated hydrophobic polyvinylidene, polyvinylidene difluoride, mixed esters of cellulose nitrate and cellulose acetate, hydrophobic polyvinylidene difluoride, hydrophilic polyvinylidene difluoride, laminated and unlaminated polytetrafluroethylene, microfiber glass, cellulose and polypropylene. Once toxins are bound to the substrate other binding sites, which remain on the substrate, are blocked by contacting them with an "inert" binding agent such as bovine serum albumin or other suitable blocking agent.

Once the toxin is bound to the substrate a labeled antibody, which exhibits a specificity for the toxin, also referred to herein as anti-toxin, is bound to the toxin. Antibodies suitable for use in the present invention include monoclonal and polyclonal antibodies. The preparation of such antibodies, specific for a desired toxin, are well known in the art. In some cases it may be necessary to conjugate the toxin to a protein to "mask" the toxicity of the antigen. Otherwise injection of the toxic antigen may result in the death of the animal in which the antibodies are to be prepared. Methods of conjugating compounds are well known in the art and one

such method is described by Hokama *et al.*, *Mycotoxins and Phycotoxins '88*, A Collection of Invited Papers at the Seventh International IUPAC Symposium of Mycotoxins and Phycotoxins, Tokyo, Japan 1988, pp. 303-310 (Elsevier Science Publishers, Amsterdam), which is incorporated herein by reference.

In one embodiment of the present invention the antibody is labeled with a colored latex bead. The preparation of antibodies labeled with colored latex beads is well known in the art. Such labeled antibodies may be prepared by diluting latex beads in a solution such as phosphate-buffered saline (8.1 mM Na_2HPO_4, 1.5 mM KH_2PO_4, 137 mM NaCl, 1.6 mM KCl) and mixing the solution gently to suspend and distribute the latex beads in the solution. Preferably, about a 10% (wt/v) suspension of latex beads is diluted about 1:100, to give a suspension of about 0.1% (wt/v) latex beads. An antibody solution is added to the latex bead suspension. Preferably, about 0.3 to about 0.6 mg of antibodies are added for each mg of latex beads, however, this ratio will vary depending on the specificity and sensitivity of the antibody preparation and the type of support being used. The amount of antibody to be used for the preparation of labeled antibodies is derived experimentally, using different dilutions of the antibody preparation. After addition of the antibody, the solution is gently mixed and incubated at about 4°C for about 16 to about 20 hours. At the completion of the incubation, the labeled antibodies are washed with phosphate-buffered saline, and the sensitivity and specificity of the labeled antibody preparation are tested.

The sensitivity and specificity of the labeled antibodies are tested by coating a substrate with a preselected amount of toxin. When contacted with the labeled antibody, the labeled antibody binds to the toxin, resulting in the development of the desired color on the substrate. The color which develops will not be washed off by rinsing in a solution such as phosphate-buffered

saline. Binding of the antibody to the toxin results in the development of color for the bar code pattern forming a bar code detector system named by the owner of this invention the SIRA BAR™ system. In effect, the labeled antibodies act as a type of "ink" so the bar code pattern can be visualized.

In use with raw meat products, the bar code detector system is exposed to juices from the meat. The juices collect in the collector and come in contact with the bar code system. If a toxin is present in the juices, the antibodies will release from the bar code pattern and bind to the toxins present in the juices, thus altering or destroying the bar code pattern. Such antibody type assays are in and of themselves well known in the art and are referred to as competitive assays.

A consumer can detect the presence of the toxin in the food product by a visual inspection of the bar code system. If the consumer does not notice the alteration of the bar code, it is detected by bar code reader 24 at the check-out counter (FIG. 5) because store computer is configured to emit an alarm to warn that a altered bar code system has been detected. The contaminated products can then be replaced with non-contaminated products.

A labeled antibody is one means of indicating the presence of a toxin or other contaminant in the juices of a food product. Those skilled in the art will be aware of other indicators such as chemical indicators, which are useful in the practice of the present invention. Instead of destroying the bar code, the bar code could be altered in some other way, e.g., by change of color, depending on the nature of the indicating system. In general, the alteration of the bar code is detectable by the bar code reader so contamination of products can be automatically determined by the electronics. Thus, the invention presents a format or vehicle to utilize existing toxin or contaminant indicating systems more effectively.

The bar code reader can also be used to indicate whether packaged products are in satisfactory condition at the time they left the supplier. If contaminated products are detected in the processing stream, the supplier can find out the source of contamination and implement remedial steps to ensure that the source of contamination is eliminated.

The same toxin could be used for all the bars of the bar code system or one or more toxins could be used for different bars. In this way a number of contaminants or toxins, that are commonly associated with a particular food, can be detected by a single bar code system. The bar code system would not only indicate that the food was contaminated but would also indicate the type of contamination.

In another embodiment of the present invention shown in FIGs. 6-10, the contamination indicator is incorporated in a bar code system having two components--one component inside the package and another component outside the package. A substrate 28 is attached to the bottom of an absorbent liner 30. Such liners are well known in the art. The liner is an absorbent material that draws juices and other fluids away from the meat to the surface of substrate 28. Substrate 28 is preferably pervious to the juices of the food product, but it does not need to be transparent. The position of substrate 28 on liner 30 is precisely set. As illustrated in FIGs. 7 and 8, one component of the bar code system comprises visible indicator elements 27 and 29 printed on the exposed surface of substrate 28. Indicator elements 27 and 29 may include a bar, a symbol, letters, or a combination thereof. In the illustrated embodiment indicator element 27 comprises a bar, given the trademark SERA BAR™ by the owner of this invention, and indicator element 29 comprises the word "NOT". Indicator elements 27 and 29 are printed on substrate 28 using labeled antibodies as "ink", as described above.

In this embodiment, the bottom of styrofoam tray 10 has a window 21 formed by a transparent sheet of material such as MYLAR® (a trademark of DuPont) using a suitable adhesive to seal the MYLAR to the styrofoam material. The liner and tray are designed so the liner can be precisely positioned in the bottom of the tray. For example, liner 30 could be dimensioned so that when it is placed in tray 10 it fills the bottom of the tray with substrate 28 in register with window 21. In this way, the close fit between liner 30 and tray 10 serves to insure that indicator elements 27 are precisely positioned with respect to the second component of the bar code system, which is placed on the exterior of the bottom of tray 10 and wrap material 14. Alternatively, ridges (not shown) could be molded into the inside bottom surface of tray 10 to position liner 30 precisely and hold it in place.

As illustrated in FIG. 9, the second component of the bar code system comprises a word 30 and a plurality of bars 31 printed on an opaque substrate 32 with ordinary ink and cut out sections 33 and 34 die cut from substrate 32. Section 33 is smaller than bar indicator element 27. Section 34 is larger than word indicator element 29. Bars 31 perform the normal product identifying function of a bar code, i.e., they represent price, unit price, type of product, origin, and weight or quantity. Substrate 32 has the same dimensions as window 21 and is placed on the outside of wrap material 14 so substrate 32 coincides with window 21. As a result, the position of substrate 32 is precisely set relative to substrate 28 so that indicator elements 27 and 29 are aligned with cut outs 33 and 34, respectively, and are normally visible from outside the package. Indicator element 27 completely fills cut out section 33 and indicator element 29 fits totally within cut out section 34. In the illustrated embodiment, word 30 is "CONTAMINATED".

When substrates 28 and 32 are aligned, the first and second components fit together to form the bar code

system. As illustrated in FIG. 10A, the words "NOT CONTAMINATED" are visible from the exterior of the package and indicator element 27 and bars 31 can be read by a bar code reader when no contaminants are present in the food juices inside the package. When contaminants are present, the labeled antibodies from which indicator elements 27 and 29 are formed react with the toxin and are removed from the substrate 28. As illustrated in FIG. 10B, this leaves only word 30 and bars 31 visible. In the absence of element 27, the bar code reader senses that the bar code system is "defective" and in the absence of element 29 humans can visually observe that the contents of the package is "CONTAMINATED".

Since it is desirable to detect different toxins in different food products it is also desirable, to place indicator element 27 in different locations on substrate 28 and cut out 33 in different locations on substrate 32 aligned with the locations on substrate 28, depending upon the toxin to be detected.

The described two component bar code system can be used to great advantage with the conventional bar code applicator machines used to mark food products in supermarkets. Such machines have a conveyor on which wrapped food packages are transported past a weighing station and a bar code label application station into a temporary storage bin. At the label application station a label carrier roll is feed past a printer where the product information is printed on the bar code labels (substrate 32) and under a blade where the bar code labels are released from the carrier and picked up by one or more robot arms for delivery to the packages. A worker punches a product identification code into a key pad. A controller calculates from the product identification code and from the weight the product information to be printed on the label such as price, weight, unit price, and historical data, i.e., origin, and controls the printer to print the bar code pattern and alphanumeric characters on

the labels. The controller coordinates, i.e., times, the operation so the labels are applied to the proper packages.

A preferred method will now be described for using the two component bar code system with a modification of the conventional bar code applicator machines used to mark food products such as meat, poultry, or fish, in supermarkets. In a central processing plant, indicator elements 27 and 29 are printed on substrates 28 with a labeled antibody or other contaminant detector as ink; then substrates 28 are mounted on liners 30 in a precise relative position and packed in shipping cartons. Liners are so prepared in separate cartons for each of a number of different toxins or contaminants and tray sizes. The cartons are shipped to the supermarkets or packaging facility where the food products are packaged in trays, wrapped, and bar code labeled with the bar code applicator machine. The packaging operation takes place in the following order--

1. For each different toxin or contaminant, one of the corresponding liners is placed in a tray sized for the particular liner.

2. The food product is placed in the tray.

3. The food product and tray are covered with the wrap material.

4. The package is placed in a bar code applicator machine and the product identification code is entered through the keyboard.

6. The package is weighed in the machine and transported by the conveyor to the label application station.

7. The bar code applicator machine is modified to incorporate a label cutting die or die set in the path of the carrier between the roll and the printer. The die is adjustable in position and its position is set by the controller depending upon the particular product identification code. Each time a bar code label passes

the die, the die is actuated by the controller to form the die cut sections (33 and 34 in FIG. 9).

8. The printer is operated by the controller to print words 30 and bars 31 on the bar code labels with ordinary ink.

9. The bar code labels are applied by the machine to a precise location on the outside of the packages in alignment with substrates 28 (FIG. 6).

In summary, the first component of the bar code system, which requires tight manufacturing controls, is produced at a central processing plant. At the supermarket, workers without any special skill can reliably incorporate the first component into food product packages and add the second component of the bar code system in the usual way, i.e. with a bar code applicator machine. The only special training for the workers at the supermarket is the proper selection and placement of the liner (30 in FIG. 6). If a worker makes a mistake in selection or placement of a liner, bar 27 is not aligned with cutout 34 and the bar code reader senses the mistake. This provides a check to ensure that the correct toxin detecting bar has been used with the correct food product.

Substrate 32 is preferably opaque and white, or at least light in color to create a strong contrast with the bar codes, which are preferably printed in a dark color. For this reason cutouts 33 and 34 are required so substrate 32 does not hide visual elements 27 and 29 of substrate 28. If sufficient contrast is otherwise available, substrate 32 can be transparent and the cutouts can be eliminated.

In the embodiment of FIG. 11, the contamination indicator is also incorporated in a bar code system having two components--one component inside the package and another component outside the package. One component comprises a transparent bag 37 constructed from a bottom panel 36 and a top panel 38. Bag 37 is placed over hole 18 and the bottom panel 36 is secured to tray 10 by

adhesive to seal hole 18 and form a window. Bottom panel 36 is fabricated from a substrate that is impervious to the food juices. A first antibody against the toxin of interest is bound to an area of the interior surface of bottom panel 36 identical in size and shape to or larger than hole 18. Top panel 38 is fabricated from a semipermeable membrane. The top and bottom panels are sealed together at their edges by use of an adhesive or other suitable method such as heat, to form a sealed bag, i.e., bag 37. Prior to sealing the bag a solution including a labeled second antibody against the toxin of interest is introduced into the bag. Although the first and second antibodies could be the same, they are preferably different. Thus, the second antibody preferably recognizes different antigenic determinants on the toxin than the first antibody. The second antibody is labeled with an indicator such as a colored latex bead so that the resultant labeled antibody is of a large size. The labeled antibody, present in the solution, is at a dilute concentration so that light will readily pass through the solution and so that little or no color is discernable.

The semipermeable membrane has a pore size which is large enough to allow the toxin of interest to enter the bag, but which is small enough to prevent the labeled antibody from leaving the bag. Such membranes are well known in the art and are commercially available in a variety of pore sizes. The pore size of the semipermeable panel is selected so that the toxin of interest will pass through the semipermeable panel to the interior of the bag.

When a toxin is present in the juices of a meat product packed in the tray, the toxin passes into the bag through semipermeable panel 38 and binds to antibodies bound to panel 36. The toxin also binds to the labeled second antibody present in the solution in the bag. As a result, panel 36 becomes colored by the sandwich assay of

the first antibody, the toxin, and the labeled second antibody, thereby indicating the presence of a toxin in the juices.

The second component comprises bar code system 16 printed on substrate 20, which is a transparent material such as MYLAR®. Substrate 20 is placed over hole 18 on the exterior of the meat tray, and preferably outside wrap material 14. When a toxin is not present in the juices panel 36 remains clear and the bar code system can be easily read against the clear background. When a toxin is present in the juices, the toxin binds to panel 36 and to the labeled antibody such that the substrate background becomes densely colored. In a preferred embodiment the color of the beads used is black and the uncolored background is white or clear. The dense color of the first component prevents the bar code of the second component from being distinguished from the background by the bar code reader. This effectively obliterates or changes the bar code system and indicates that the food contained in the package is contaminated.

A variation of the two component bar code system of FIG. 11 is partially illustrated in FIG. 12. Panel 36 is secured to the underside of liner 30 using an adhesive or other suitable means of attachment. The liner is an absorbent material that draws juices and other fluids away from the meat to the surface of semipermeable panel 38 and serves to align bag 37 with hole 18, in the manner described in connection with FIG. 6. The juices pass through the semipermeable panel and into the interior of bag 37. On the interior of surface of panel 36 antibodies are attached as described above. The antibodies are attached to a rectangular area 39 on the inside surface of panel 36 such that when the liner is placed in the food tray rectangular area 39 aligns with hole 18. Substrate 20 is attached to the outer surface of tray 10 after tray 10 has been covered with wrap material 14. A bar code system is printed on substrate 20 by the bar code

applicator machine. The presence of toxins are then detected as described above.

In another embodiment of the invention shown in FIGs. 13 and 14, a symbol such as a colored dot 42 is printed on a porous substrate 40. Substrate 40 is designed to be attached to the surface of a beef carcass or other bulk food product to determine if the carcass is contaminated. The "ink" used to print the dot is labeled antibodies attached to toxin as described above. In the illustrated embodiment, substrate 40 is in two parts--a porous indicator strip 45 and an opaque holder strip 44 that covers and secures the indicator strip in place. The labeled antibody is bound to a square area 43 of the indicator strip. Substrate 40 comprises flexible material which fits the contour of the carcass and keeps the indicator strip in contact with the surface of the carcass. A circular hole 47 is cut in the holder strip and area 43 aligns with the hole, so that when the substrate and holder strip are attached to the carcass colored dot 42 appears. If toxins are present in the meat of the carcass the antibody becomes unbound from area 43 and the dot disappears to indicate the presence of toxins in the carcass. Substrate 28 is attached to the carcass by use of stainless steel staples 46. The holder strip may also be used to display other identifying information, such as a bar code system 48 and printed matter 50. Bar code system 48 and printed matter 50 could be printed with ordinary ink.

The present invention is not to be limited to the specific embodiments shown which are merely illustrative. Various and numerous other embodiments may be devised by one skilled in the art without departing from the spirit and scope of this invention. For example, with respect to the embodiments of the present invention illustrated in FIGs. 6-12, while the invention is described for use with antibodies against a single toxin, mixtures of antibodies, against a number of different toxins could be used. With

the use of different antibodies, multiple, different toxins which could be present in the meat sample can be detected. Also, while the invention is described primarily in relation to obliterating a bar code, the antibody bound to the substrate could also be in the form of a symbol or wording which appears, or disappears depending on the type of antibody-toxin "assay" used. Such a symbol or wording could be read without the aid of a bar code reader. Also while some embodiments are described in conjunction with a liner, these bar code systems could also be used in the absence of a liner. Similarly, embodiments described without a liner could be used in conjunction with a liner. The scope of the invention is defined in the following claims.

WHAT IS CLAIMED IS:

1. A food contamination detector comprising:

a food tray for containing food;

an indicator in communication with juices from the food;

means for changing the color of the indicator when a toxin is present in the juices from the food.

2. A food contamination detector as recited in claim 1 wherein the means for changing the appearance of the indicator changes the color of the indicator.

3. A food contamination detector as recited in claim 1 wherein the indicator comprises a substrate and an antibody attached to the substrate.

4. A food contamination detector as recited in claim 3 wherein the means for changing the appearance of the indicator comprises a label attached to the antibody such that the antibody dissociates from the substrate in the presence of the toxin.

5. A food contamination detector as recited in claim 4 wherein the label comprises a latex bead.

6. A food contamination detector as recited in claim 2 wherein the means for changing the color of the indicator comprises a label and an antibody attached to the label, the antibody binding to the substrate in the absence of the toxin.

7. A food contamination detector as recited in claim 6 wherein the label comprises a latex bead.

8. A food contamination detector as recited in claim 1 wherein the indicator is a bar code that becomes illegible when the toxin is present.

9. A food contamination detector as recited in claim 1 wherein the change in the indicator is a symbol that becomes illegible when the toxin is present.

10. A food contamination detector as recited in claim 1 wherein the indicator comprises:

a first anti-toxin attached to a transparent substrate; and

a solution in contact with the first anti-toxin attached to the transparent substrate, wherein the solution comprises a labeled second anti-toxin and wherein the labeled second anti-toxin becomes bound to the transparent substrate rendering the substrate opaque in the presence of a toxin in the juices from the food.

11. A food contamination detector as recited in claim 10 wherein the solution comprising the second antibody is enclosed in a compartment.

12. A food contamination detector as recited in claim 11 wherein the compartment comprises a semipermeable membrane.

13. A food contamination detector as recited in claim 10 wherein the first anti-toxin recognizes an antigenic determinant on the toxin which is different from the antigenic determinant on the toxin recognized by the second anti-toxin.

14. A food contamination detector as recited in claim 10 further comprising a bar code aligned with the transparent substrate.

15. A food contamination detector as recited in claim 10 wherein the transparent substrate seals a hole in a food tray.

16. A food contamination detector as recited in claim 1 wherein the indicator includes markings which are removed in the presence of a toxin, the detector additionally comprising:

a bar code aligned with the indicator such that the combination of the presence of markings on the indicator and the bar code forms an intact visible indicator.

17. A food contamination detector as recited in claim 16 wherein the markings on the indicator are formed by labeled antibodies bound to a substrate.

18. A food contamination detector as recited in claim 16 wherein removal of the markings from the indicator strip results in a defective indicator.

19. A food product package comprising:

a tray in which the food product lies;

a transparent wrap covering the tray and the food product;

a first product information component disposed inside the wrap so it is visible from the exterior of the package, the first component comprising a first substrate and one or more first visual elements printed on the first substrate with a contaminant detecting material; and

a second product information component disposed outside the wrap, the second component comprising a second substrate aligned with the first substrate without hiding the first visual elements and a plurality of second visual elements printed on the second substrate with a non-contaminant detecting material.

20. The package of claim 19, in which the tray has a window formed in its bottom, the first component additionally comprises an absorbent liner that is dimensioned to fit in the tray in a predetermined position relative to the window, and the first substrate is attached to the bottom of the liner in alignment with the window when the liner is in the predetermined position.

21. The package of claim 20, in which the second substrate is aligned with the window and the first substrate.

22. The package of claim 21, in which the second substrate is opaque and has one or more cutouts and the one or more visual elements of the first substrate are visible through the one or more cutouts.

23. The package of claim 19, in which the first and second elements together form a bar code.

24. A method of detecting contamination in food comprising:

placing food that creates food juices in a tray;

placing in contact with the juices in the tray an indicator the appearance of which changes in the presence of a toxin; and

sensing the appearance of the indicator to determine if the food is contaminated.

25. A method as recited in claim 24 wherein the step of placing an indicator in contact with the juices comprises stapling the indicator directly to the food to be tested.

26. A method as recited in claim 24 additionally comprises the step of forming the indicator by attaching an antibody to a substrate.

27. A method as recited in claim 26 wherein the forming step additionally comprises attaching a label to the antibody so the antibody dissociates from the substrate in the presence of the toxin.

28. A method as recited in claim 27 wherein the forming step attaches a latex bead as the label.

29. A method as recited in claim 24 wherein the indicator is a bar code and the change in appearance of the indicator makes the bar code unreadable by a bar code reader.

30. A method for packaging food product subject to contamination, the method comprising the steps of:

printing one or more visible contaminant indicating elements on a first substrate with a material that visibly changes when subjected to a contaminant to be detected;

placing the first substrate in a food tray;

placing the food product in the tray;

wrapping the tray and the product in a sheet of transparent material so the first substrate is visible;

printing a plurality of visible product identifying elements on a second substrate; and

applying the second substrate to the exterior of the sheet in alignment with the first substrate without hiding the one or more contaminant indicating elements.

31. The method of claim 30, in which the step of placing the first substrate in a food tray comprises attaching the first substrate to one surface of an absorbent liner and placing the one surface of the liner in contact with the bottom of the tray in a predetermined position and the method additionally comprises the step of forming a window in the bottom of the tray in alignment with the first substrate.

Fig. 1

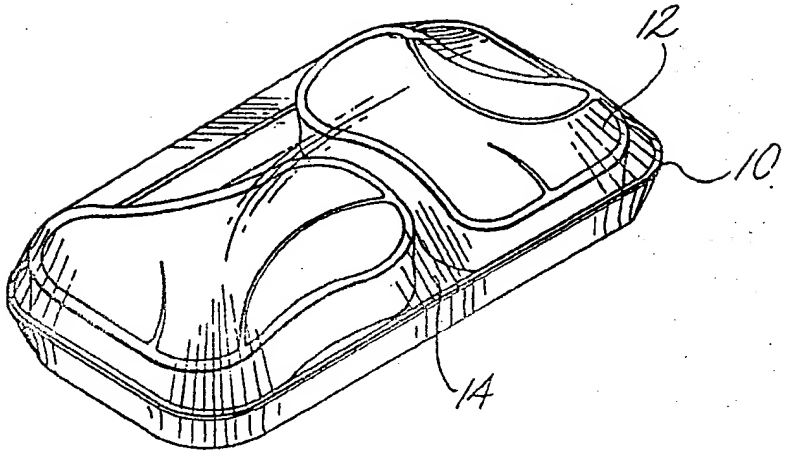


Fig. 2

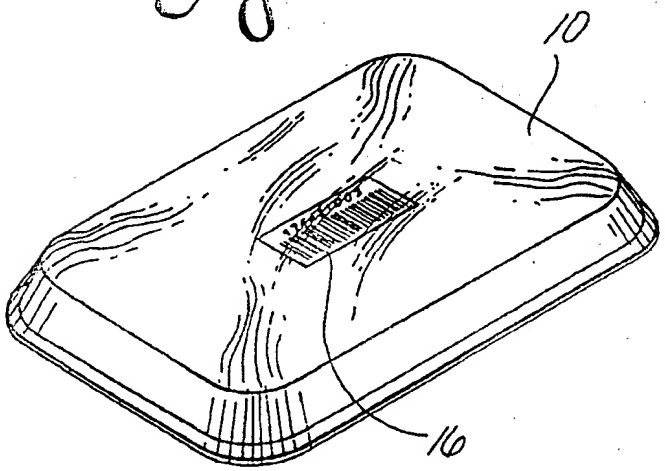


Fig. 3

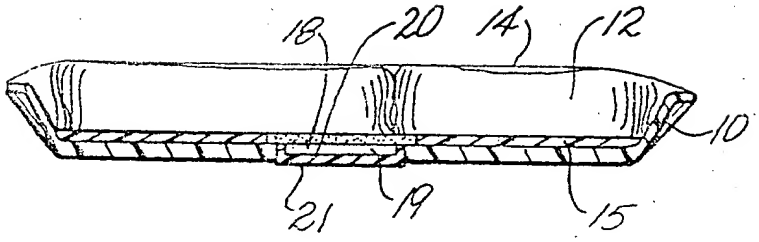


Fig. 4

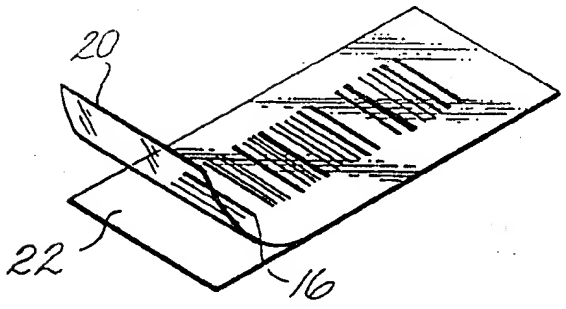


Fig. 5

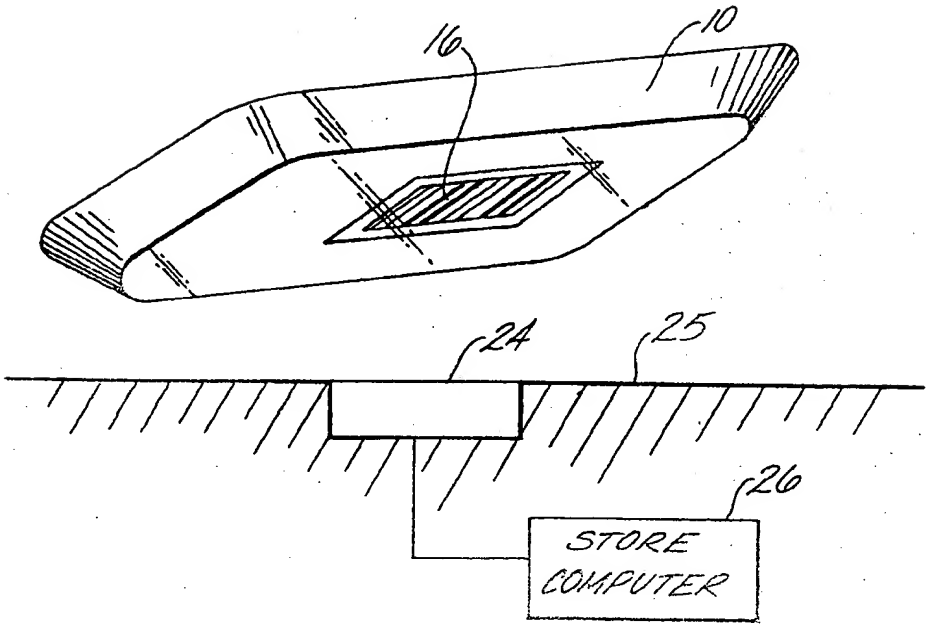


Fig. 6

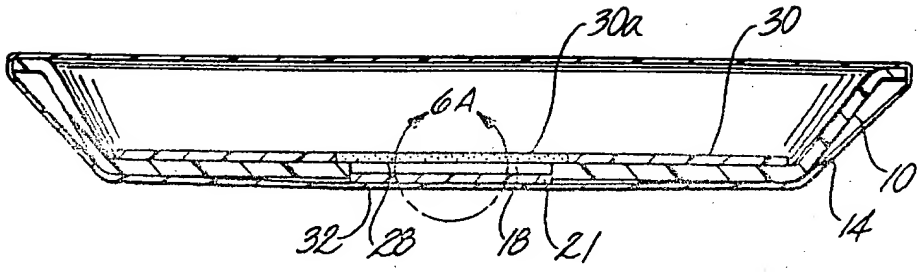


Fig. 6A

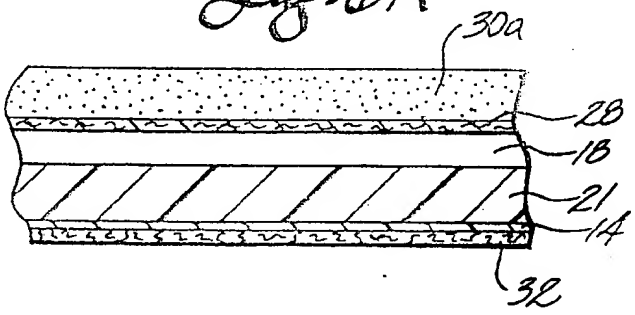
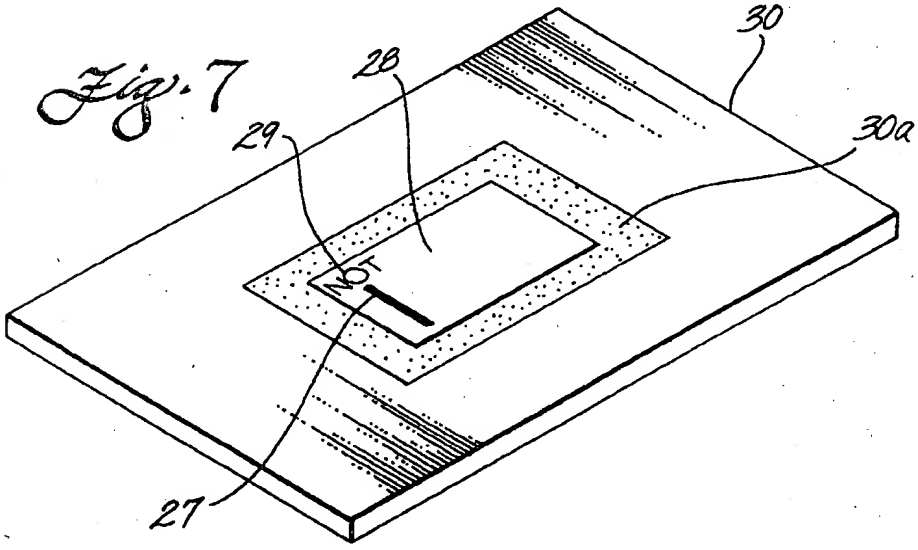


Fig. 7



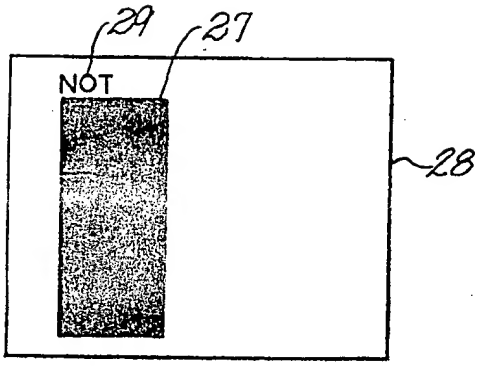


Fig. 8

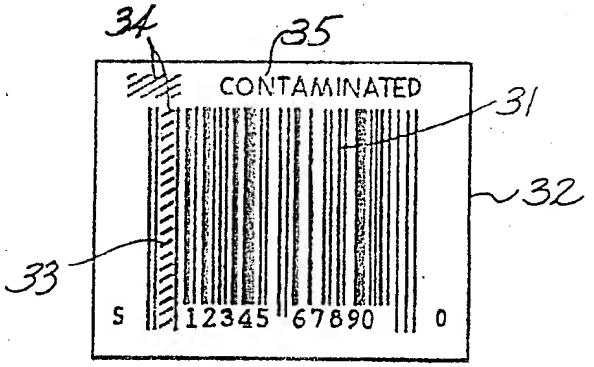


Fig. 9

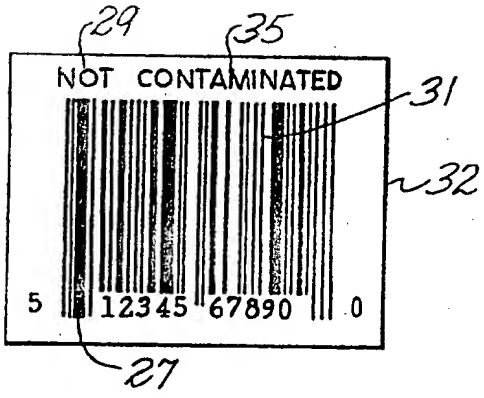


Fig. 10A

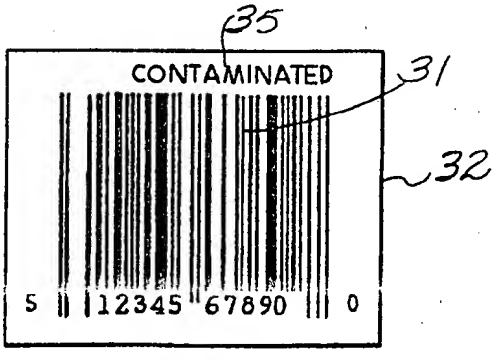


Fig. 10B

Fig. 11

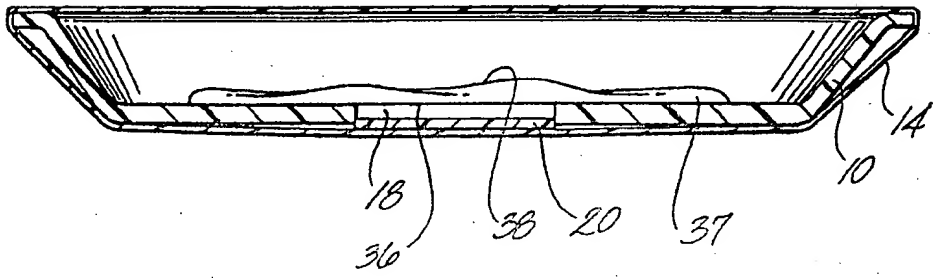


Fig. 12

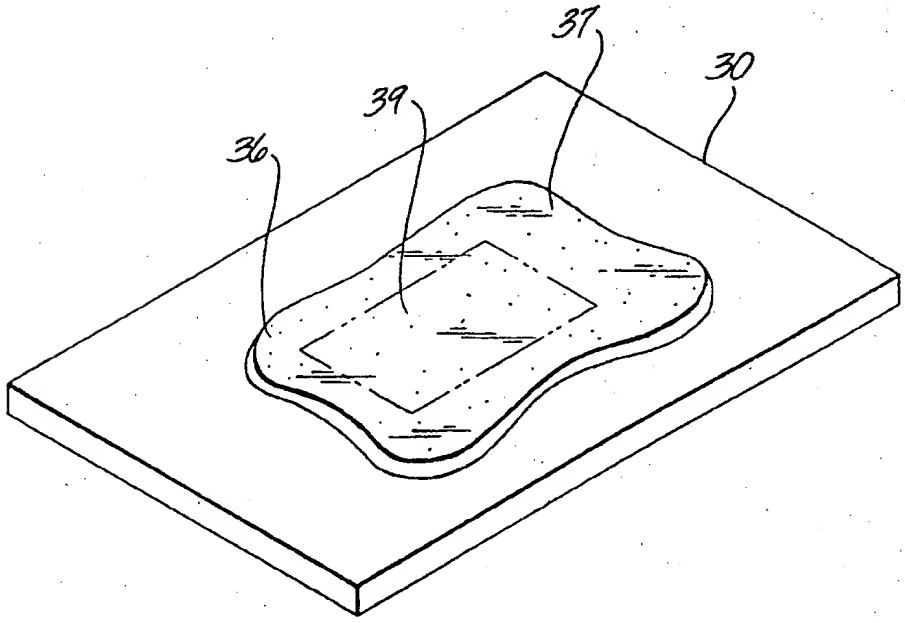


Fig. 13

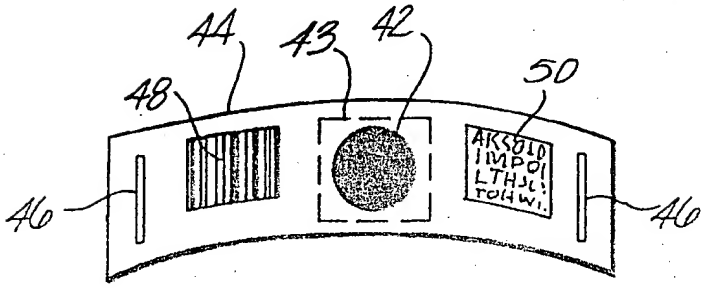
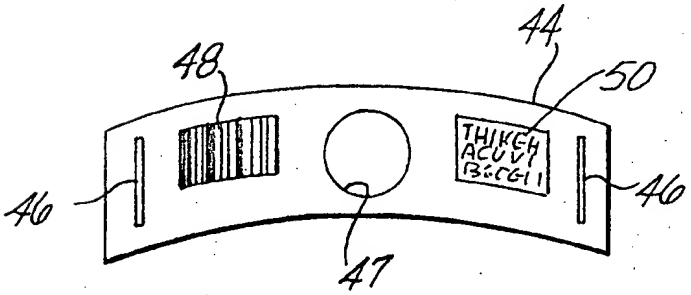


Fig. 14



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 94/05511

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 G01N31/22 G01N33/569 B65D77/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 G01N C12M C12Q B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 746 616 (DAVID E. HONIGS; JONATHAN H. PERKINS; BRADLEY J. TENGE) 24 May 1988 see the whole document	1,2,24, 25
Y	see the whole document	1-4, 24-26
Y	GB,A,2 234 587 (CHISSO CORPORATION) 6 February 1991 see the whole document	1-4, 24-26
A	see the whole document	1-7, 24-28
A	WO,A,91 19003 (BIOTECH AUSTRALIA PTY LIMITED) 12 December 1991 see the whole document	1-7, 10-13, 24-28

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 September 1994	07.10.94

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 94/05511

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 285 697 (MICHAEL P. NEARY) 25 August 1981 see the whole document	1,2
A	see the whole document	1-4, 10-12, 24,25, 30,31
A	EP,A,0 069 037 (GUY CHARVIN) 5 January 1983	

INTERNATIONAL SEARCH REPORT

..information on patent family members

International application No.
PCT/US 94/05511

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		FR-A-	2650673	08-02-91
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